HoverClub

... freedom to explore!

The Cruising Hovercraft Club

Light Hovercraft Code of Practise

Rev 5A

1 Foreword

1.1 Scope

This Code has been developed for application to United Kingdom (UK) Hovercraft class Private Light Hovercraft. This Code applies to Private Light Hovercraft which are not being used for hire, reward or commercial purposes.

1.2 Purpose of Code

The primary aim in developing the Code has been to set standards of safety and protection for all persons on-board. The level of safety it sets out to achieve is considered to be commensurate with the current expectations of the general public. The Code relates especially to the construction of a craft, its' machinery, equipment and stability and to the correct operation of a craft so that safety standards are maintained.

In addition, designers and builders of hovercraft will need to pay special regard to the intended area of operation and the working conditions to which a craft will be subjected when selecting the materials and equipment to be used in its construction.

1.3 Bylaws

Compliance with the Code in no way obviates the need for hovercraft operations to comply with relevant bylaws made by either the local/navigation authority or the port/harbour authority for the area in which the craft operates. Local authorities may, for instance, have powers to require craft to have passenger liability and third-party insurance cover, and to set the level of that cover. Additionally, recognising that some craft operate both at sea and on inland waterways, attention is drawn to the common approach to craft safety adopted by the major UK Inland Navigation Authorities. Owners/managing agent(s) of such craft should also comply with any applicable requirements of any relevant authority for the area of operation. It should also be noted that local authorities may also have powers over the use of the foreshore and landing places, and to issue licenses for their use.

1.4 Environmental Designations

Hovercraft operations should respect any environmental designations applicable to the area in which the craft operates. For example, in England, Marine Protected Areas (MPAs) are designated in territorial waters to protect marine wildlife of national and international importance. These include Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Sites of Specific Scientific Interest (SSSIs), Ramsar sites and Marine Conservation Zones (MCZs). Hovercraft operation ***other than navigation in accordance with the public right of navigation in tidal waters*** may require consent from the relevent body.

1.5 Limitation of liability

The builder, repairer or owner/managing agent of a hovercraft, as appropriate, should take all reasonable measures to ensure that a material or appliance fitted in accordance with the requirements of the Code is suitable for the purpose intended, having regard to its location in the craft, the area of operation and the weather conditions which may be encountered.

It is important to stress that, whilst all reasonable measures have been taken to develop standards which will result in the production of safe and seaworthy craft, total safety at sea can never be guaranteed.

Responsibility for the safety of the craft remains with the owner/managing agent, skipper or pilot at all times.

2 Definitions

In this code the following definitions apply

“Annual examination” means a general or partial examination of the craft, its machinery, fittings and equipment, as far as can readily be seen, to ascertain that it had been satisfactorily maintained as required by the Code.

“as amended” refers to any other document that replaces, revokes or amends the document that the term “as amended” follows;

“Authorised person” means a person who by reason of relevant professional qualifications, practical experience or expertise is authorised by the owner/managing agent to carry out examinations required under Section 23 of the Code. A properly qualified owner/managing agent may self authorise.

“Cargo” for the purpose of the Code means all items which are transported by the craft except fuel for the craft, ballast (either solid or liquid), consumables to be used on board, permanent outfit and equipment of the craft, stores and spare gear for the craft, crew and their personal baggage and passengers and their personal baggage, and activity related equipment;

“Category C, D etc waters” means waters designated category C, D, etc waters in the Merchant Shipping (Categorisation of Waters) Regulations 1992, (SI 1992 No. 2356), as amended, and Merchant Shipping Notice MSN 1827(M) – Categorisation of Waters;

“Certificate of compliance” means the certificate appropriate to a craft to which the Code is applied;

“Code” means this Code unless another Code is specified;

“Compartment” means all living and working spaces within the watertight or fire-resisting boundaries on any one level which have inter-communicating access;

“Compliance examination” means an examination of the craft, its machinery, fittings and equipment, by an authorised person, to ascertain that the craft’s structure, machinery, fittings and equipment comply with the requirements of the Code. All examinations should be conducted when the craft is out of the water.

“Control position” means a conning position which is continuously manned whilst the craft is under way;

“Crew” means a person employed or engaged in any capacity on-board a craft on the business of the vessel;

“Efficient” in relation to a fitting, piece of equipment or material means that all reasonable and practicable measures have been taken to ensure that it is suitable for the purpose for which it is intended;

“Favourable weather” means conditions existing throughout a voyage or excursion in which the effects either individually or in combination of swell, height of waves, strength of wind and visibility cause no hazard to the safety of the craft, including handling ability;

“Freeboard” means the distance measured vertically downwards from the lowest point of the upper edge of the weather deck to the floating waterline in still water or, for an open craft, the distance measured vertically downwards from the lowest point of the gunwale to the floating waterline or, the lowest point of the crafts structure that will allow flooding to occur;

“Fully enclosed” means a cabin or habitable area with a roof that must be accessed by a door or

hatch which may be closed. Areas which may be enclosed by removable structures shall be treated as enclosed when the structure is in place.

“Hovercraft” or Air Cushion Vehicle (ACV) is a craft such that the whole or a significant part of its weight can be supported, whether at rest or in motion, by a continuously generated cushion of air dependent for its effectiveness on the proximity of the surface over which the craft operates.

“Immersion Suit” means a protective suit which reduces the body heat-loss of a person wearing it in cold water and complies with the requirements of Schedule 10, Part 1 of Merchant Shipping Notice MSN 1676 (M) – “The Merchant Shipping (Life-Saving Appliances for Ships Other than Ships of Classes III to VI(A)) Regulations 1999. The Merchant Shipping (Life Saving Appliances for Passenger Ships of Classes III to VI(A)) Regulations” (SI 1999 No. 2721, SI 1999 No. 2723), as amended;

“Land” means the sea shore above the line of mean high water mark;

“Length means the overall hard structure length from the foreside of the foremost fixed permanent structure to the aft side of the aftermost fixed permanent structure of the rigid hull, excluding removable parts that can be detached in a non-destructive manner without affecting the structural integrity of the craft such as skirts and stem head fittings;

“Lift Fan” means any fan that provides a flow of air to the hovercraft air cushion, at suitable pressure, to provide lift. This category of fan includes axial, centrifugal and mixed flow.

“Loose Water” means minimal amounts of water that have accumulated within spaces on a craft through operational use but which are not associated with hull damage;

“Machinery space” is an enclosed region which contains propulsion or lift machinery.

“Maritime and Coastguard Agency” means the Maritime and Coastguard Agency (MCA), an executive agency of the Department for Transport, and any superseding organisation;

“Merchant Shipping Act”, “Merchant Shipping Order”, “Merchant Shipping Regulations” and “Merchant Shipping Rules” referred to in the Code mean the reference specified and includes the document issued under the appropriate statutory power which either amends or replaces the reference specified;

“Mile” means a nautical mile of 1852 metres;

“Open craft” for the application of the Code means a craft which within its length is:

1 not fitted with a watertight weather deck; or

2 is fitted with a watertight weather deck over part of its length.

“Owner/managing agent” means the registered owner, or the owner or managing agent of the registered owner or owner, or owner ipso facto, as the case may be, and “Owners/managing agents” should be construed accordingly;

"Passenger" means any person carried on a Hovercraft except:

(a) a person employed or engaged in any capacity on the business of the craft,

(b) a person on board the craft either in pursuance of the obligation laid upon the master to carry shipwrecked, distressed or other persons, or by reason of any circumstance that neither the master nor the owner nor the charterer (if any) could have prevented or forestalled,

(c) a child of under one year of age.

“Plough In” – a divergent pitch motion involving an increase in drag and reduction in pitch attitude.

“Propulsion fan” means an axial fan producing propulsive forces for a hovercraft. In this code these fans are considered to be multi-bladed fans commonly manufactured for use in ventilating devices and comprise of fixed pitch injection moulded thermoplastic blades clamped in a hub. Such fans

will be fixed pitch (or ground adjustable) and would normally be installed as a part of a ducted unit. Note fans used for both lift and thrust are considered as propulsion fans.

“Propulsion Propeller” means an axial device specifically selected for providing a propulsive force for hovercraft. The device will have been designed to provide thrust for transport. The propeller can be either fixed or variable pitch.

"Safe haven" means a harbour or shelter of any kind which affords safe entry and protection from the force of weather; this includes areas of land such as beaches that a Hovercraft can land on.

“Shore” means the edge of the land/water at the time of operation.

“Skipper” means every person (except a marine pilot) having command or charge of the craft. The terms Pilot, Captain, Driver, Master, Coxswain should be taken as having the same meaning for the purposes of this Code of Practice.

“SOLAS” means the International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1988, as amended;

Standards such as BS (British Standard), EN (European Standard accepted by the European Committee for Standardization, CEN), IEC (International Electrotechnical Commission) and ISO (International Organization for Standardization) identified in the Code should include any standards which amend or replace them;

"To sea" means, for the purpose of this Code, beyond Category D waters, or Category C waters if there are no Category D waters, as defined in Merchant Shipping Notice 1827 (M) – “Categorisation of Waters”;

“Vessel” means any ship to which the Merchant Shipping (Small Workboats) Regulations 1998 (SI 1998 No. 1609), as amended or the Merchant Shipping (Vessels in Commercial Use for Sport or Pleasure) Regulations 1998 (SI 1998 No. 2771), as amended, apply; In addition the term “Vessel”, Craft and “Hovercraft” are interchangeable within this document.

“Unladen Weight” or “Light Craft Weight” means the actual weight of the craft in tonnes without cargo, fuel, lubricating oil, ballast water, freshwater, consumable stores, passengers and crew and their effects;

"Watertight" means capable of preventing the passage of water in either direction;

"Weather deck" means the main deck which is exposed to the elements;

"Weathertight" means capable of preventing the admission of a significant quantity of water into the vessel when subjected to a hose test;

“Yaw angle” The yaw angle, in the horizontal plane, is the angle between the longitudinal axis of the hovercraft and instantaneous direction relative to the sea bed.

3 Application and interpretation

The code is recommended for applicable to private light hovercraft of less than 1000kg unladen weight carrying up to 8 passengers which are not engaged in navigation in activities for hire reward or commercial activities.

It is the responsibility of the owner/managing agent to ensure that a craft is properly maintained, examined and manned in accordance with the Code. The Code applies whether the owner/managing agent is corporate, private or of a charitable nature.

3.1 Areas of Operation

Area Category 3 – Up to 20 miles from a safe haven or as defined on the Certificate.

Depending on the nature of the craft and its use, it may be restricted to less than the above specified limits. Such a restriction should be recorded on the Light Hovercraft Certificate for the craft and should be limited to operations within Area Categories 2, 3, 4, 5 and 6 only.

3.2 Certification

To be issued with a certificate for a particular area of operation, a craft must comply with all of the requirements of the Code for that operating area. A certificate is to be valid for not more than five years.

3.3 Carriage of Additional Equipment

Equipment on board which is expected to be relied on in situations affecting safety or pollution prevention must be in an operating condition. If such equipment is inoperative and is in excess of the equipment required by this Code it should either be repaired, removed or if removal is not practical, clearly marked as inoperative and secured.

4 Construction and Structural Strength

4.1 Structural Strength

4.1.1 General

The design of hull structure and construction should provide strength and service life for the safe operation of the craft at the maximum service speed, to withstand the sea and weather conditions likely to be encountered in the intended area of operation.

4.1.2 Load cases

The design of the craft should take into consideration all reasonable combinations of loading cases where these are likely to result in critical loadings of the craft.

The design assessment of the structure should consider the following loading cases and have Proof and Ultimate Factors of 1.0 and 1.5 respectively under the maximum loads which can arise within the Design Environmental Conditions and Craft limitations for which certification is sought.

- Light Craft
- Manoeuvring loads
- Water impact loads
- Towing loads
- Machinery loads
- Floor loads

4.1.3 Construction Materials

A craft may be constructed of wood, fibre reinforced plastic (FRP) with or without core materials, aluminium alloy, high-density polyethylene or combinations of such materials including such materials as used in the construction of inflatable and rigid inflatable boats.

All materials shall be resistant to or protected from fuel, water and salt water.

4.1.4 Acceptance of hull strength

A craft will be considered to be of adequate strength after a design appraisal and a satisfactory examination by an authorised person and if it has been built:

1. In general accord with the standard of a craft which has a record of at least five years' history of safe operation in an area where the sea and weather conditions are no less severe than those likely to be encountered in the intended area of operation.
2. By plan approval or practical demonstration provided that full information (including calculations, drawings, details of materials and construction where applicable) is available in the form of a technical file and is approved by an authorised person to meet any one of the following:

Light Hovercraft ISO 12215-5 simplified scantling assessment.

Refer to tables below for typical scantlings based on craft length (Tr = Fibre Reinforced Plastic single skin/Al = Aluminium)

Drop test from ISO 12215-5 Annex B

1st principle methodologies which demonstrate acceptable scantling dimensions.

Craft Particulars			Craft Particulars			Craft Particulars		
Length	4000	mm	Length	6000	mm	Length	8000	mm
Mass	1.25	t	Mass	1.875	t	Mass	2.5	t
b	2000	mm	b	2000	mm	b	2000	mm
Kc	1.100000000000000		Kc	1.100000000000000		Kc	1.100000000000000	
Kloc	1		Kloc	1		Kloc	1	
Kr	0.77		Kr	0.77		Kr	1	
c	0	mm	c	0	mm	c	0	mm
Panel L	2000	mm	Panel L	2000	mm	Panel L	4000	mm
Tr	2.279311718	mm	Tr	2.605636557	mm	Tr	3.720941967	mm
Alu	1.527138851	mm	Alu	1.745776493	mm	Alu	2.493031118	mm

4.1.5 Watertight Bulkheads

The strength of a watertight bulkhead and the effectiveness of any alternative means should be adequate for the intended purpose and to the satisfaction of the Certifying Authority.

When pipes, cables, etc. penetrate watertight bulkheads, they should be provided with valves and/or watertight glands, as appropriate.

5 Weathertight Integrity

Light Hovercraft can be considered as open craft and so any form of cabin structure will be regarded as non weathertight.

5.1 Doorways

A doorway located above the deck which gives access to spaces inside the craft should be of efficient construction, permanently attached to the bulkhead, not open inwards, and sized such that

the door overlaps the clear opening on all sides, and has efficient means of closure which can be operated from either side.

5.2 Windows

Windows or screens which do not form part of an enclosed weathertight boundary must not be made of materials that could cause danger to persons on-board if broken.

6 Machinery

6.1 General Requirement

Generally, machinery installations should comply with the requirements given below. Other installations proposed may be specially considered, provided that full information is presented to and approved by the Certifying Authority.

6.2 Attitude

The main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the vessel should be designed to operate when the vessel is upright and when inclined at any angle of heel and trim up to and including 15 degrees and 7.5 degrees respectively either way under static conditions.

6.3 Diesel Engines

A Hovercraft fitted with a diesel engine should be provided with an engine suitable for Hovercraft use and with sufficient fuel tankage for its area of operation. It should be noted that marine engines typically require cooling by sea water and are therefore unlikely to be suitable.

6.4 Petrol Engines

Private Light Hovercraft, may use inboard petrol engines provided that the engine, fuel system and tanks, ventilation arrangements, fire protection and electrical arrangements are compliant with the ISO standards listed in Appendix 1.

A petrol engine shall be a suitable type and meets the requirements of 6.3.2. The total maximum power of petrol engines installed in a Hovercraft is to be less than 175hp (130kW). Only fuel injected petrol engines should be fitted when the machinery compartment is fully enclosed.

6.5 Fuel tanks

Craft should supply fuel to the engine from either;

1. a permanently installed fuel tank constructed to an appropriate standard (see Standards Appendix 1) and shall have arrangements such that spillage during fuel handling will drain into a suitable receptacle to prevent it draining overboard; or
2. a portable tank or tanks of 30 litres or less in capacity complying with an appropriate standard (see Standards Appendix 1).

A vessel should be provided with sufficient fuel tankage for its area of operation, spare portable petrol containers must not be carried on board unless it is judged to be essential to assure the safe completion of a voyage or excursion (see Section 6.6).

Attention is drawn to the electrical arrangement requirements (Section 7).

6.6 Installation

The machinery, fuel tank(s) and associated piping systems and fittings should be of a design and construction adequate for the service for which they are intended. These should be installed and protected so as to reduce to a minimum danger to persons during normal movement about the vessel, with due regard being paid to moving parts, hot surfaces and other hazards.

6.7 Fuel system

Means should be provided to isolate a source of fuel which may feed a fire in an engine space. A valve or cock, which is capable of being closed from a position outside the engine space, should be fitted in the fuel feed pipe as close as possible to the fuel tank or a spill proof fuel pipe connector which allows rapid disconnection of the fuel supply.

Fuel filling and venting pipes should be constructed of fuel compatible non-kinking material, adequately supported and of sufficient dimensions to prevent spillage during filling.

A venting pipe should be led to the open atmosphere, terminating in a position level with or higher than the fuel filling mouth and its open end should be protected against:-

1. water ingress - by a goose neck or other efficient means; and
2. for petrol engines or where there is a risk from flame ingress - by a suitable gauze diaphragm (which can be detached for cleaning).

The fuel piping system should be manufactured from metal piping; However flexible pipe may be used and shall befire resistant/metal reinforced or otherwise protected from fire (see applicable Standards in Appendix 1). The flexible pipes shall be secured by either metal hose clamps or permanently attached end fittings (e.g. swaged sleeve or sleeve and threaded). Where hose clamps are used, the fitting to which the flexible pipe attaches should have a bead, flare, annular grooves or other means of preventing slippage, the anti-slippage arrangement shall not provide a path for fuel leakage.

Water separators should be fitted in the fuel supply system. When the main engine(s) fuel system is provided with water separator filter(s) of a type which has plastic or glass bowl(s), it should be located so that it can be easily seen and protected against heat and accidental damage.

6.8 Engine Starting and Stopping

An engine should be provided with either mechanical, hand starting or electric starting.

When the sole means of starting is by battery, the battery should be in duplicate and connected to the starter motor via a ‘change over switch’ so that either battery can be used for starting the engine. Charging facilities for the batteries should be available. Under normal circumstances it is not recommended to discharge both batteries in parallel. A single battery may be used providing that visual indication of proper battery charging is provided.

All internal combustion machinery should have a secure means of remote stopping from outside the engine space.

An open craft when fitted with remote throttle controls should be fitted with a kill-cord, or fly back throttle.

6.9 Stowage of Petrol

When spare petrol is carried on-board in portable containers, for any purpose, the quantity should be kept to a minimum, the containers should be clearly marked and should normally be stowed where they can be readily jettisoned and where spillage will not drain into an enclosed space.

In craft where this is not practicable, a 5 litre container of petrol may be stowed in a deck locker

which meets the following requirements:

1. vapour tight to the crafts interior
2. not openable from the crafts interior
3. adequately drained and ventilated to atmosphere

6.10 Propeller and Fan Systems

Hovercraft require fans and/or propellers to move air for use in lift and thrust systems.

In determining these requirements a range of similar requirements were reviewed, including:

Organisation	Regulation	Reference	Safety Factor[1]
British Hovercraft Safety Regulations	CAP 458	Chap B7-5 section 3.3.1	3
British Microlight Aircraft Association	TIL 011	Part B section 5.4	3
Civil Aviation Authority Microlight Standards	CAP 482	AMC S 1935 & S303A	3
World Hovercraft Federation	WHF010		2

Note 1: Different documents use different terms such as proof factor, ultimate factor, etc which are considered synonymous with safety factor in this discussion

Of the regulations reviewed, all require a that safety facor of 3.0 be considered, except for the HCGB regulations that require a factor of 2.0. This, together with strong anecdotal evidence of frequent failure of fans used under the HCGB regulation, leads to the adoption of a combined proof and ultimate load factor of 3.0

6.10.1 Materials

Materials used in propeller and fans shall conform to specifications that ensure they have the strength and other properties assumed in the design. The suitabiliy and durability of those materials must be established by experience or test.

Strength tests on propellers and fans shall be conducted on minimum strength materials or the test load shall be increased to simulate the effect of minimum strength materials.

In particular the strength of composite materials such as glass reinforced nylon are subject to degradation by exposure to environmental factors such as atmospheric moisture, and this must be taken into account either by testing suitably aged materials or by increasing the test load in proportion to the expected strength degradation.

6.10.2 Blade retention

Blade retention devices shall be capable of withstanding a pull load equal to twice the centrifugal loads occuring at the maximum rotational speed multiplied by an ultimate factor of 1.5.

6.10.3 Blade retention test

The blade retention integrity shall be tested per the procedure in Appendix 4.

This test may be waived where reliable evidence of integrity in similar applications is available from the propeller or fan manufacturer or other sources.

6.10.4 Suitable propellers and fans

A list of suitable fans and propellers is maintained by the Hoveclub together with the maximum speed for each type. The maximum speed of selected fans must at all times be kept within the maximum approved speeds

6.10.5 Propeller or fan location

All fans shall be located so that a wave strike is an unlikely occurrence. The lowest part of the fan shall be above the minimum freeboard line (See section 12), shall be protected by fairings or otherwise from isolated waves as defined in section 12.2, and shall be protected against loose water.

6.11 Fan/Propeller guarding

All fans/propellers shall be protected by suitable means upstream to prevent the ingress of objects greater than 50 mm diameter, which are caught in the airstream.

All fans/propellers shall be protected from the front and sides such that it is not possible to place a finger, arm or other part of the body into the path of the fans/propellers. It shall not be possible to reach the path of the rotating assembly with a 12mm diameter rod of 100mm length when approached from outside the fans/propellers guard.

The exit area shall be protected to ensure that any person standing behind the craft cannot place a hand into the path of a rotating assembly.

All guards shall be capable of resisting a force of 450N placed on an area 100mm x 100mm without deflecting into the path of the rotating assembly.

Applying a load of 450N to any point on the hovercraft structure shall not cause any part of the hovercraft structure or guarding to enter the path of the rotating assembly.

6.12 Fan/propeller containment

Fans and propeller systems shall be designed to minimize the risk of failure. Consideration shall be given to containment of failed blade fragments all-round the circumference of rotating fans and propellers. This can take the form of a duct or guard.

A proposed containment shall be considered acceptable where evidence exists from similar systems. Similarity shall be defined as similar materials, construction, blades, maximum rotating speed.

A proposed containment may also be considered acceptable where it is shown analytically or by test that it is suitable for the purpose.

6.13 Transmissions

Failure of all belts and transmission shafts shall be considered. Arrangements shall be made to prevent shafts and belts flailing in the event of failure, by the use of suitable guards and anti-flail devices. Where multiple fans/propellers are driven from a single engine, the failure of any one component (e.g. drive belt) shall be considered in the fans/propellers speed and strength calculations. Also the overspeeding of any rotating component by any failure of any transmission

components must be considered.

7 Electrical Arrangements

7.1 General

Electrical installations must be such that they will not suffer damage or corrosion as a result of the environment.

7.2 Systems

All hovercraft may use single conductor circuits but no hull earth returns are permitted.

7.3 Emergency Lighting

An alternative source of lighting, which may be a suitable portable battery operated lamp(s) should be provided. This alternative source of lighting should be sufficient to:

1. illuminate survival craft launching and embarkation (if fitted);
2. illuminate man-overboard rescue equipment and rescue areas;
3. permit work on essential machinery.

7.4 Batteries

7.4.1 Battery System Requirements

The battery terminals should be protected against accidental contact with metallic objects.

Battery charging systems should be fitted with circuitry to prevent overcharging.

A battery cut-out switch should be provided for all systems. It is preferred that this switch acts as an isolator, i.e. Double pole. However, single pole is acceptable on the positive conductor. If a battery change-over switch is fitted and is provided with an "off" position, this may serve as the cut-out switch also.

Batteries should be of the sealed type to prevent electrolyte loss.

7.4.2 Battery Stowage

All batteries should be secured firmly to avoid movement when the vessel is subjected to sudden acceleration or deceleration.

Where the maximum charging power output is less than 0.2 kilowatts (kW) the batteries may be located in any suitable space without any special container requirements.

Where the maximum charging power output is between 0.2 and 2.0 kW the batteries should be located in the machinery space or other well-ventilated space in a box or locker.

7.4.3 Battery Ventilation

To ensure that any evolved hydrogen is expelled, battery compartments, lockers and containers should be exhausted from the highest point of the space and air supplied at a level below the top of the batteries.

7.5 Cables

It is recommended that electric cables should be constructed to a recognised standard for marine use in small craft.

Cables which are not provided with electrical protection should be kept as short as possible and should be “short circuit proofed” e.g. single core with an additional insulated sleeve over the insulation of each core. Normal marine cable, which is single core, will meet this requirement without an additional sleeve, since it has both conductor insulation and a sheath.

Note that when selecting cables, particular attention should be given to environmental factors such as temperature and contact with damaging substances, e.g. polystyrene, which degrades PVC insulation.

Adequate provision should be made for securing electrical connections e.g. by use of locking washers.

7.6 Hazardous Spaces

Where practicable, electrical equipment should not be installed in a space where petroleum vapour or other hydrocarbon gas is likely to accumulate. When equipment is installed in such a space it must comply with a recognised standard for prevention of ignition of a flammable atmosphere.

8 Steering Gear and Rudder Systems

8.1 Steering

A vessel should be provided with efficient means of steering.

The control position should be located so that the person conning the craft has a clear view for the safe navigation of the vessel.

When steering gear is fitted with remote control, arrangements should be made for emergency steering in the event of failure of the control. This could include, but is not limited to locking the steering amidships and using weight shift or skirt shift to control the direction of the craft.

8.2 Rudder System

As appropriate to the craft, the rudder and supporting structure construction materials, design in total (including actuating cylinders, connecting rods, attachments, bearings and pintles) and the supporting structures should be adequate for the operating conditions of the vessel.

9 Loose Water Removal

9.1 General System Requirements

A craft should have an efficient pumping system, with suction pipes so arranged that any compartment (other than a tank permanently used for the carriage of liquids) can be drained.

When considered necessary to protect the suction line from obstruction, an efficient strum box should be provided.

When considered necessary, to prevent back flooding, non-return valves should be fitted.

Means of providing efficient pumping other than those described in this text may be considered provided that full information is submitted to the authorised person.

Craft of 6 metres in length and over, should carry a hand bailer or bucket in addition to a pump.

For craft of less than 6 metres in length and operating in Category 6, a minimum of one hand powered pump bailer or a bucket is to be provided.

10 Skirt design and attachment

10.1 Stability

The skirt system shall be such as to ensure adequate stability when hovering under all operating conditions. Adequate stability is defined as follows:

For the craft trimmed level in a static hovering condition, the skirt shall provide sufficient righting moments in the conditions of maximum design speed and maximum design environment of wind and waves or hard surface so as to prevent unpredictable or dangerous plough-in.

The righting moment generated by the skirt system in pitch and roll shall steadily increase at a linear or greater rate with rotation, up to the point when the hull contacts ground or water.

10.2 Hard Structure Clearance

Average Hard structure clearance (with the skirt hem trimmed level over a flat surface) should not exceed 12.5% of hard structure width (Hard Structure Width/8) unless it can be demonstrated that both dynamic and static stability characteristics are adequate, by calculation and/or trials in accordance with section 10.1.

10.3 Cushion Pressure Design

Where the dynamic air pressure at the maximum feasible air speed of the craft may exceed the cushion pressure, it shall be shown by calculation or test that this does not cause skirt collapse.

10.4 Construction and Materials

Attachments of the skirt to the hull shall be of sufficient strength so that no damage is caused to the hull attachment if the skirt material is ripped or snagged with sufficient force to break the skirt connecting device or tear the skirt.

Attention should be paid to the configuration of seams on a bag or loop so that rips will be stopped by the seams rather than guided by them.

Skirt attachments shall be designed to withstand the loading due to skid stops on land.

10.5 Operational Damage

The craft shall maintain stability sufficient to prevent capsize in the event that any part of the skirt should collapse and be dragged back by the water surface during operation at a maximum operational speed in any direction of yaw as defined in the craft operational manual.

The skirt should be designed so that damage to any part or area of the skirt will not cause other parts or areas of the skirt to fail as a direct consequence.

In the design and construction of skirts, consideration should be given to the problems associated with:

1. Scooping that may induce excessive loads in skirt materials or attachments.
2. Drainage of water collected when floating off-cushion or in normal operation.
3. Deterioration of material strength due to sunlight or ozone during the life of the craft.

11 Stability

11.1 Off Cushion - Intact

With the lift system not operating, a craft should be tested in its all up weight condition to ascertain the angle of heel and the position of the waterline which results when all persons which the craft is to be certificated to carry are assembled along one side of the normal passenger area (the skipper may be assumed to be at the craft control position). Each person may be substituted by a mass of 82.5kg for the purpose of the test.

The craft will be judged to have an acceptable standard of stability if the test shows that:

1. the angle of heel does not exceed 7 degrees and the freeboard to deck should not be less than 150 mm at any point; or
2. if unable to meet the criteria above the angle of heel may exceed 7 degrees, but should not exceed 10 degrees provided that the freeboard is not less than 150mm at any point.

For craft carrying a combination of passengers and cargo, the test should be carried out with the full complement of passengers and cargo, and additionally with passengers only. For the purposes of these tests the cargo may be assumed to be retained at its normal stowage position.

In all cases, the all up weight of persons and/or cargo derived from the tests conducted shall be recorded on the certificate.

11.2 Person Recovery Stability Test

For craft of 4 seats and above only.

Two persons should recover a third person from the water into the craft. The third person should feign to be unconscious so as not to assist the rescuers. The third person should also wear suitable anti-exposure clothing (e.g. dry suit or immersion suit). Each person involved should wear an approved lifejacket. The craft should remain stable throughout the operation, and should not capsize. The craft maybe on cushion or off cushion as deemed appropriate by the operator and in line with the intended operation of the craft.

11.3 Off Cushion – Open Craft Swamped

For open craft it should be demonstrated by test or by calculation that the craft, when fully swamped, is capable of supporting its full outfit of equipment, the total number of persons for which it is to be certificated and a mass equivalent to its engine and full tank of fuel. The craft should float sufficiently to provide a stable platform for the crew and passengers.

11.4 On Cushion

Hovercraft should be provided with information relating to the safe speed and yaw angle operational envelope for pitch and roll stability.

11.4.1 Pitch stability on cushion

The craft should demonstrate adequate pitch stability when operated up to the maximum

design speed. In flat water conditions the hull should not enter the water unless commanded to do so e.g. as part of a braking manoeuvre.

The craft should not suffer excessive decelerations as a result of any uncommanded pitch down event (“plough-in”). Excessive is defined as great enough to unseat a passenger (0.3 g).

11.4.2 Roll stability on cushion

The craft should be stable when operated in yaw up to the maximum speed specified for the yaw angle with passengers located in their normal seating position.

12 Freeboard

12.1 Off cushion

When floating with the lift system not operating, the freeboard for a hovercraft should be not less than that determined by the following requirements:

Have a clear height of side (i.e. the distance between the waterline and the lowest point of the gunwale or any other lower point of water ingress such as into the craft, excluding wet plenums if used) of not less than 200mm for craft or 4m or less and not less than 300mm for craft of 6m or more. Between 3m and 6m the freeboard requirement shall be determined by linear interpolation.

Hovercraft that incorporate a design intended to permit water to flow freely over a buoyant structure may be accepted based on a demonstration that essential systems are capable of operating in such conditions.

12.2 On cushion wavestrike

Encountering an isolated steep sided wave of 0.75m (eg. large vessel bow wave) within the operational limit of the craft and at a speed of 20 knots in a forward direction shall not cause water to damage any essential equipment. It is permitted for loose water to enter the craft but this must not cause the craft to become unstable.

13 Life-Saving Appliances

13.1 Equipment marking

All life-saving equipment must be marked in accordance with the guidelines in Marine Guidance Note MGN 105 (M+F) – “Use and Fitting of Retro-reflective Material on Life-saving Appliances”.

13.2 Mud escape

Craft expected to operate over soft sand and mud shall have mud escape equipment to allow all persons to walk over soft mud without becoming trapped. This may be derived from standard craft equipment such as seats which are modified for the purpose.

13.3 Lifejackets

Lifejackets should be worn at all time when on or over water.

Lifejackets should be MCA (DfT) or MED approved (“Wheelmarked”) or should comply with BS EN ISO 12402, Part 3 or Part 6, for lifejackets of 150 Newtons or BS EN ISO 12402, Part 2, for lifejackets of 275 Newtons or equivalent ISO/CEN standard.

Lifejackets that comply with BS 3595, BS EN 399 or BS EN 396 and with a current servicing certificate, where applicable, may continue to be used where already fitted on a vessel at the time of the Code coming into force.

All lifejackets should be fitted with a whistle, light and retro-reflective materials.

13.4 Portable VHF Radio

Each craft shall be fitted with a fixed VHF radio complying with the requirements of Section 15 or shall carry a portable VHF radio with charging facilities or spare batteries. Arrangements should be made to protect the portable VHF and spare battery or batteries from water damage e.g. waterproof cover.

14 Fire Safety and Appliances

14.1 Fire extinguishers

14.1.1 Craft with open spaces only

A minimum of two multi-purpose portable fire-extinguishers should be provided as the fire extinguishing medium.

At least one portable fire-extinguisher is to be located so that it can easily be reached from the main steering position of the craft and the other within close proximity of the machinery space.

Craft should be fitted with fire extinguishers to a recognised standard, each with minimum fire rating of 13A/113B, or smaller extinguishers giving the equivalent fire rating.

14.1.2 Craft with enclosed interior spaces

Enclosed interior spaces are to be provided with a sufficient number of portable fire-extinguishers to ensure that at least one extinguisher appropriate to fire risk will be readily available for use in every compartment.

Portable fire-extinguishers should be stowed in readily accessible positions.

Portable fire-extinguishers intended for use in the space are to be stowed near the entrance to that space.

At least one portable fire-extinguisher is to be located so that it can easily be reached from the main steering position of the craft.

Where cooking facilities are provided a portable fire-extinguisher of a type appropriate to the energy source used and a fire blanket is to be located in a position readily accessible for use in the event of a fire.

Craft should be fitted with a minimum of two multi-purpose portable fire extinguishers to a recognised standard, each with minimum fire rating of 13A/113B, or smaller extinguishers giving the equivalent fire rating.

14.2 Insulation

Thermal or acoustic insulation fitted inside the machinery space should be of a non-combustible material.

The thermal or acoustic insulation will be considered as being a non-combustible material if it complies with BS EN ISO 4589 Part 3, and the material has an Oxygen Index greater than 21.

Insulation should be protected against impregnation by flammable vapours and liquids. Where insulation is cut, the edges should be protected against such impregnation, e.g. by the use of non-combustible tape. Where the insulation is vulnerable to damage it should be protected.

14.3 Furnishing Materials

It is recommended that Combustion Modified High Resilient (CMHR) foams are used in upholstered furniture.

Upholstery covering fabrics should satisfy the cigarette and butane flame tests of a recognised standard.

15 Radio Equipment

15.1 General

Each craft should carry sufficient radio communications equipment to perform the following distress and safety communications functions throughout its' intended voyage.

transmitting and receiving ship to shore and ship to ship distress alerts, and

rescue co-ordinating communications

maritime safety communications

15.2 Radio Installation

Aerials should be mounted as high as is practicable to maximise performance.

On craft with an enclosed superstructure a fixed radio installation should be installed and be clearly marked with the vessel's call sign, any other codes applicable to the use of the radio, and a Maritime Mobile Service Identity (MMSI) where applicable. A card or cards giving a clear summary of the radio distress, urgency and safety procedures should be displayed in full view of the radio operating position(s).

Radios installations should be:

1. so located to ensure the greatest possible degree of safety and operational availability;
2. protected against the harmful effects of water, extremes of temperature and other adverse environmental conditions;
3. marked with the call sign, the vessel station identity and any other codes applicable to the use of the radio installation.
4. Be capable of use whilst underway in particular having regard to noise levels and the need for headets and noise cancelling microphones.

15.3 Radio Watches

A craft, while at sea, should maintain a continuous radio watch where practicable, on

VHF Channel 16, 13 and DSC Channel 70.

15.4 Radio Personnel - Guidance

A craft should carry at least one person qualified for distress and safety radio communication purposes, who should hold a certificate of competence acceptable to the relevant authority.

15.5 Ships' Radio Licence - Guidance

Owners/managing agents should be aware that a craft with radio communications equipment on board is required to have a Ships' Radio Licence issued by the relevant authority.

16 Navigation Lights, Shapes and Sound Signals

A craft should comply with the requirements of the Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996, (SI 1996 No. 75), as amended. A craft which operates only between sunrise and sunset, and in favourable weather, is not required to carry navigation lights where it can be demonstrated that the craft will not be caught in restricted visibility.

Sound signalling equipment should comply with the requirements of SI 1996 No. 75, as amended. A craft of less than 12 metres in length is not obliged to carry the sound signalling equipment required by SI 1996, No.75, provided that some other means of making an efficient sound signal is provided.

The table below is a summary table of navigation lights, shapes and sound signalling appliances for craft. This Table is for guidance only and does not cover all possible operations.

Table of Lights, Shapes and Sound Appliances

Overall Length (metres)	Craft when underway	At anchor	Not under command	Sound Appliances
Less than 7m	All round white + sidelights **OR** Combined Lantern **OR** White Light where the above are not practicable + all around flashing yellow light.	All round white where best seen when at Anchor in the water only at night. May be dual purpose all round white as used when underway.	Not required	Means to make an effective sound signal such as a portable gas fog horn
7m-12m	All round white + sidelights **OR** masthead (vis 2 miles) + sidelights + stern light **OR** (if lights have to be offset from centreline) combined lantern sidelights plus **either** all round white or masthead and sternlight + all round flashing yellow light	All round white where best seen at night when at Anchor in the **water only**. May be dual purpose all round white as used when underway. Anchor ball.	Not required	Means to make an efficient sound such as a portable gas fog horn

17 Navigational Equipment

17.1 Magnetic Compass

Light Hovercraft should carry a suitable marine handheld compass on board or be fitted with a properly adjusted magnetic compass

17.2 Other Equipment

It is recommended that Light Hovercraft should be provided with and use whilst in navigation a a portable or fixed receiver for global navigation satellite system or a terrestrial radio navigation system, or other suitable means to establish and update the crafts position at all times.

18 Miscellaneous Equipment

18.1 Nautical Publications

Light Hovercraft need not carry publications. An electronic chart plotting system, complying with the requirements detailed in Marine Guidance Note MGN 319 (M+F), may be accepted as meeting the chart carriage requirements of this sub-paragraph.

18.2 Signalling Lamp/Waterproof Torch

A craft should be provided with an efficient waterproof electric lamp/torch suitable for signalling and as a searchlight.

18.3 Radar Reflector

Where it is not practicable for an efficient radar reflector to be fitted, light hovercraft must not put to sea in fog, and if visibility starts to deteriorate they are to return to shore.

19 Anchors

19.1 Anchor type

It is recommended that An anchor should be carried, which shall be of a suitable type for the size and type of hovercraft. The anchor warp provided may be also double as a towline.

The anchor shall be of suitable construction and holding power for the operating area under consideration.

19.2 Tow Line

A craft should be provided with a towline. Where practicable, the towline should be buoyant. As noted in 20.1.1 the anchor warp may be used as the towline.

A strong securing point or equivalent structure should be provided for attachment of the towing line.

20 Protection of Personnel

20.1 Enclosed Superstructure(s)

Enclosed superstructure deckhouses must be constructed of adequate strength to withstand the forces of weather and sea to which it will be subjected in use.

20.2 Surface of Working Deck

The surface of a working deck should be non-slip.

21 Noise

21.1 Standard hovercraft noise test

The standard hovercraft noise test is defined to replicate as far as is possible the most usual noise levels observed by bystanders as a hovercraft passes during normal navigation, as though the craft were passing up a channel with persons standing on the bank.

In calm sea conditions in a location with minimum opportunity for noise reflections and at the lowest practicable wind speed the noise shall be recorded at a fixed location as the craft passes at a steady 16knts +/-1 (18+/-1mph) at a distance of 25m+/-1m. The sound meter shall be mounted 1m above the water level. A laser rangefinder or similar shall be used to determine the distance to the craft.

The noise recording equipment shall be set to the dBa slow range. The maximum observed value

shall be recorded.

21.2 Observed noise requirement

The maximum noise recorded in the standard noise test shall be 78dBA.

22 Procedure for certification and annual inspection

22.1 Procedure

Hovercraft within the classes covered by this Code shall be certified and annually inspected by an authorised person appointed by the owner/managing agent. It is recommended that an independent authorised person should be appointed but the owner/managing agent may appoint himself providing that he is suitably qualified

A craft shall be initially examined and certified as meeting this Code. Following this the craft shall be inspected annually to ensure that it continues to meet the requirements of the Code.

22.2 Procedures for craft initial examination and certification

An authorised person shall undertake a compliance examination of the craft.

The arrangements, fittings and equipment provided on the craft are to be documented on the certificate of compliance report form.

Sea Trials are to be carried out by an authorised person on the first of type by all manufacturers of recreational craft prior to issuing a certificate of compliance.

Sea trial results are to be completed and documented and should include:

- Plough in effect and boundary
- Yaw/Speed Curve
- Emergency stop
- Intact stability, if not proven by calculation
- Skirt drainage including start from stationary over water
- Manoeuvring trial at slow speed
- Start from stationary off-cushion on water at maximum payload

The owner/managing agent should provide the authorised person with information necessary to confirm that the stability of the craft meets the standard required by the Code.

Upon satisfactory inspection of the craft and review of the documented arrangements, fittings and equipment provided in compliance with the Code, the authorised person will issue the Certificate of Compliance and the first Annual Inspection Report.

22.3 Annual Examination by the Owner/Managing Agent

On the anniversary of the initial compliance inspection (+/- 3 months) an authorised person shall carry out an annual re-examination of the craft. to confirm that the arrangements, fittings and equipment provided on board are in a satisfactory condition and remain as documented in the certificate of compliance. Also that the craft, its machinery, fittings and equipment are in a sound and well maintained condition, and where necessary serviced at the required period.

Where a craft has been modified and no longer conforms to the original certificate of compliance in any respect, the authorised person shall reinspect the modifications for compliance with this Code, and shall determine whether further sea trials are required.

Following a successful examination a certificate of annual inspection shall be issued by the authorised person.

22.4 Examination Regime.

Private Light Hovercraft must be examined annually by an authorised person. Every three years the craft shall be lifted so that the underhull areas and skirt may be examined in detail.

APPENDIX 1

PETROL ENGINE STANDARDS

Petrol engines shall be accepted for craft which are less than 175hp(130kW). Craft with petrol engines should as far as reasonably practicable comply with the following standards:

1 Engine

ISO 7840	Small craft - Fire resistant fuel hoses
ISO 8846	Small craft - Electrical devices – Protection against ignition of surrounding flammable gases
ISO 9094	Small craft – Fire protection
ISO 10088	Small craft – Permanently installed fuel systems and fixed fuel tanks
ISO 10133	Small craft – Electrical equipment – Extra low-voltage DC installations
ISO 11105	Small craft – Ventilation of petrol engines and/or petrol tank compartments
ISO 15584	Small craft – Inboard petrol engines – Engine mounted fuel and electrical components.

2 Ventilation, Engine and Tank Compartments

ISO 11105	Small craft – Ventilation of petrol engines and/or petrol tank compartments.

3 Fuel System: General

ISO 7840	Small craft – Fire resistant fuel hoses
[ISO 8469	Small craft – Non-fire resistant fuel hoses]
ISO 9094	Small craft – Fire protection
ISO 10088	Small craft – Permanently installed fuel systems and fixed fuel tanks
ISO 11105	Small craft – Ventilation of petrol engines and/or petrol tank compartments
ISO 13592	Small craft – Backfire flame control for petrol engines

4 Fuel System: Tanks

ISO 10088	Small craft – Permanently installed fuel systems and fixed fuel tanks
ISO 11105	Small craft – Ventilation of petrol engines and/or petrol tank compartments

5 Fire protection

ISO 9094	Small craft – Fire protection

APPENDIX 2

EXAMPLE CERTIFICATE OF ANNUAL INSPECTION

PRIVATE LIGHT HOVERCRAFT SAFETY CERTIFICATE OF ANNUAL INSPECTION

Name of Craft…

Date of Build…

Official Number…

Craft/Hull ID No…

Overall Length (m)…

Hard Structure Length (m)…

Hovercraft Group [Light only]: Light

Craft Use [Pleasure only]: Pleasure

Name and address of owner…

This is to certify that the above named craft was examined by [Name of authorised person] at [Place of Survey] on [Date of Survey] and found to be in compliance with the requirements of the Code of Practice for the construction, machinery, stability, operation, manning and examination of Private Light Hovercraft up to 1000kg to carry up to 8 passengers.

Anniversary Date of the Certificate: [Anniversary date]

The permitted area of operation is [Area Category]

Maximum No. of persons to be carried [No.]

Maximum all up weight including persons and equipment [kg]

Maximum cargo weight [kg]

This certificate will remain in force until [Expiry date] subject to the vessel, its machinery and equipment being efficiently maintained, annual examinations and manning complying with the Code of Practice, and to the following conditions [Conditions].

Issued at [Place of issue] On [Date of issue]

Name [Name of person issuing Certificate on behalf of the owner/managing agent]

Signature [Signature of person issuing Certificate on behalf of the owner/managing agent]

Date [Date of Issue of the Certificate]

APPENDIX 3

EXAMPLE CERTIFICATE OF COMPLIANCE

HOVERCRAFT MANUFACTURERS/BUILDERS CERTIFICATE OF COMPLIANCE

Company logo

This Certificate is issued as a Declaration of Compliance under sole responsibility of the authorised person. I declare on behalf of the owner/managing agent that the craft mentioned below complies with and has been designed and built in accordance with the applicable requirements of the Private Light Hovercraft Code of Practice for the operational area recorded on this certificate.

Name/Address of Craft Manufacturer…

Name & Position of Authorised Person…

Date of Build…

Operational Area [Light (Category 3) only]

Maximum Significant wave height…

Hovercraft Group [Light only]

Craft Use [Pleasure only]

DESCRIPTION OF CRAFT

Manufacturers Model…..

Craft ID/Hull No….

All up Weight…… (Kg)

Maximum payload…(Kg)

Maximum Persons on board…..

Overall Length (m)…

Hard Structure Length (m)…

Hard Structure Beam (m)…

Hover Height….(m)

Maximum speed….(knots)

Construction Material

Aluminium ☐
Wood ☐
Plastic, Fibre Reinforced Plastic ☐
Other (specify) ☐ ……...

Type of Main Propulsion

Petrol (up to 130kW) ☐
Diesel ☐
Other (specify) ☐ ……...
Total Installed Engine power ..…… kW
Number of Engines ……..

Type of Engine and Power

Inboard (radiator cooled) ☐ Other (specify) ☐
Outboard (air cooled) ☐ ……...

Thrust Equipment

Fan ☐ Material (specify)
Airscrew propeller ☐ ……...

Directional Control

Hydraulic ☐ Other (specify)
Electric ☐ ……...

Lift System

Independent of main propulsion engine ☐ Other (specify)
Integrated with main propulsion engine ☐ ……...

Deck

Open craft ☐ Other (specify) ☐
Enclosed superstructure ☐ ……...

Compliance Matrix

Section	Requirement	Means of determining compliance (Inspection, documentation, sea trial, etc)	Comply Y/N or partial	Comments
Construction and strength				

4.1.3	Construction Materials			
4.1.5	Watertight Bulkheads			
4.1	Structural Strength			
5.1	Doorways			
5.2	Windows			
5	Weathertight Integrity			
Machinery				
6.2	Attitude			
6.3	Diesel Engines			
6.4	Petrol Engines			
6.5	Fuel tanks			
6.6	Installation			
6.7	Fuel system			
6.8	Engine Starting and Stopping			
6.10	Propeller and Fan Systems			
6.11	Fan/Propeller guarding			
6.11	Fan/propeller containment			
6.13	Transmissions			
6	Machinery			
Electrical Arrangements				
7.2	Systems			
7.3	Emergency Lighting			
7.4	Batteries			
7.5	Cables			
7.6	Hazardous Spaces			
7	Electrical Arrangements			
Steering gear				
8.1	Steering			
8.2	Rudder System			
8	Steering Gear and Rudder Systems			
Loose water				
9	Loose Water Removal			
Skirt design and attachment				

10.1	Stability			
10.2	Hard Structure Clearance			
10.3	Cushion Pressure Design			
10.4	Construction and Materials			
10.5	Operational Damage			
10	Skirt design and attachment			
Stability				
11.1	Off Cushion - Intact			
11.2	Person Recovery Stability Test			
11.3	Off Cushion – Open Craft Swamped			
11.4	On Cushion			
11	Stability			
Freeboard				
12.1	Off cushion			
12.2	On cushion wavestrike			
12	Freeboard			
Life saving appliances				
13.2	Mud escape			
13.3	Lifejackets			
13.4	Portable VHF Radio			
13	Life-Saving Appliances			
Fire safety				
14.1	Fire extinguishers			
14.2	Insulation			
14.3	Furnishing Materials			
14	Fire Safety and Appliances			
Radio equipment				
15.1	General			
15.2	Radio Installation			
15.3	Radio Watches			

15	Radio Equipment			
Navigation lights and other equipment				
16	Navigation Lights, Shapes and Sound Signals			
17	Navigational Equipment			
18	Miscellaneous Equipment			
19.1	Anchor type			
19.2	Tow Line			
19	Anchors			
Personnel protection				
20.1	Enclosed Superstructure(s)			
20.2	Surface of Working Deck			
20	Protection of Personnel			
Noise				
21.2	Observed noise requirement			

Issued at [Place of issue] On [Date of issue]

For and on behalf of [Name of Manufacturer]

Signature [Signature of authorised person issuing Certificate]

Position [Position of authorised person issuing Certificate]

Date [Date of Issue of the Certificate]

Appendix 4

Fan & Propeller Blade Strength Test

1 Introduction

Hovercraft use fans and propellers to provide propulsion and lift. These are stressed devices and failure is potentially hazardous, a procedure is therefore required to ensure that they are operated within safe parameters, and that during operation sufficient strength is retained to prevent failure in the case of unexpected incidents such as the ingestion of debris and foreign objects small enough to pass through the protective guarding.

This procedure is intended to be applied to hovercraft used in uncontrolled environments such as public slipways where the risk of fan a failure must be very remote.

2 Scope

This test procedure is intended to apply to ground adjustable fans and propellers which are in serial manufacture, and are commercially available to the manufacturers of hovercraft. This includes:

- Fans typically manufactured for operation in industrial air moving applications such as air conditioning
- Propellers which are manufactured for use in the microlight industry

This procedure may be waived if the fan or propeller manufacturer can provide evidence of equivalent or more rigorous testing and the fan or propeller is used within the maximum speeds recommended by the manufacturer.

3 Terminology

The following terms are used in this document as defined here

Safe maximum service speed: The maximum tip speed at which a propeller of fan may be used in service for the declared lifetime.

Failure load: The maximum load which was applied to the test specimen during the test, at which either failure was experienced, or if failure did not occur, the maximum load that was applied during the test

Safe maximum service load: The load on the hub at the maximum service speed, determined from the failure load after application of the safety debit factors.

Design margin: the difference between the stress at failure and the stress at the maximum working speed. This is a margin of safety that is required to account for unpredictable loads and/or fatigue loads.

Blade: The aerofoil section of a fan or propeller which is manufactured from composite materials

Hub: The central portion of the fan or propeller which retains the blades.

Ground adjustable: A variable pitch fan or propeller in which the blade is mounted in a hub allowing the pitch to be adjusted only when the fan or propeller is stationary.

Safety debit factor: A de-rating factor usually derived from published material or other data which

is used to take account of factors that cannot be simulated in the blade load test. Expressed as a number greater than 1.0 by which the Failure load is divided.

Proof load factor: A de-rating factor by which the failure load is divided, intended to provide a margin of safety in operation of the fan or propeller. This factor is used to account for unknowns in the operational environment and provides a design margin which ensures that reliability targets may be met

4 General

Fans and propellers in hovercraft use are subject to various loads. Some of these are predictable, such as the centripetal load, and some are unpredictable, such as foreign object strikes. The intent of this testing series is to ensure that the fan or propeller has sufficient strength to withstand the predictable loads, and has some reserve strength to withstand the unknown loads. It is therefore obvious that the potential for failure can never be absolutely eliminated, but by a combination of adequate reserve strength margin and proper containment, the probability of failures resulting in injury can be reduced to a satisfactory level.

Fans or propellers which are tested and found acceptable to this procedure may suddenly and unexpectedly fail. Manufacturers and operators of light hovercraft are responsible for mitigating the risk of subsequent injury and damage by proper engineering controls and operational procedures.

4.1 Loads

The following loads shall be considered:

- Centripetal

The certificate shall include an analysis of the loads and describe how these were accounted for in the testing.

4.2 Relevant material factors

Composite materials are non-linear, subject to environmental degradation, fatigue and other factors which affect the safe operating speed of the finished fan or propeller. These relevant material factors may include but are not limited to moisture content, UV aging, fatigue damage, erosion and natural variation of material properties.

All relevant material factors shall be declared in the test certificate, together with the means by which these factors have been taken into account. This may be by test or by analysis. Where relevant material factors have been accounted for by analysis, the certificate shall include details of the analysis and/or the source of the data.

The certificate shall declare the safety debit actors that have been applied, and if applicable shall declare any lifetime limits that may apply to the fan or propeller. Where material debit factors are not known a value of 1.5 shall be used.

4.3 Blade design mass and centre of gravity

The mass of the blade, not including any root details which do not contribute the loading of the critical section, and the effective radius of the centre of gravity shall be established and declared on the certificate.

5 Test procedure

5.1 General

The test shall comprise of a static application of force to the blade and hub to establish the force at which the blade and / or hub failure occurs.

Testing shall be conducted to a tensile overload procedure.

5.2 Tensile overload test

5.2.1 Test Specimen

The test specimen shall be prepared for the failure load test by installing it in a suitable tensile test facility. The blade shall be mounted in the hub with suitable fixtures arranged to apply the test loads. The blade may be shortened to facilitate testing providing that it is no shorter than the effective centre of mass of the unmodified blade.

5.2.2 Test procedure

The test load shall be applied to the specimen at a controlled rate. The load shall be applied in steps, and the time held at each load step, shall be recorded.

The maximum load shall be the highest applied load that was held for at least 5 minutes without failure.

The load at which failure occurs, or the maximum load attained, shall be recorded. This is the Failure Load.

5.2.3 Safe maximum service load

The maximum service load shall be calculated from the failure load divided by the product of the proof load factor and any declared debit factors.

5.2.4 Safe maximum service speed

The maximum service speed is calculated from the maximum service load by the following formula:

Where:

TipRadius = radius of the blade tip (m)

BladeMass = the mass of the blade (kg)

RadiusCG = the radius of the blade centre of gravity (m)

ProductOfDebits = PoofloadFactor x debit1 x debit2 x debit3 …

5.2.5 Declaration

The test result shall be recorded in a certificate which shall include the details of the testing, the debit factors applied and Failure load achieved.

Test certificate example

1 Material proof and debit factors

The <Blade Type> blade is manufactured from <Material>. This material is subject to environmental debits which are listed below:

5.3 Material debit factors:

<Insert details of the debit factor, declare the value to be used, and a reference to the source data>

5.4 Safety Factor:

A proof and ultimate load factor of 2.0*1.5 (3.0) is applied.

6 Failure load

The blade failure load was tested on the <DATE> and was found to be <LOAD> kN. This testing was witnessed by <NAME>.

7 Safe maximum speed.

The safe maximum speed is calculated from the failure load divided by the product of the debit factors as <TIP SPEED> m/s.

Fan or Propeller type	Multiwing
Manufacturer	5z
Blade material	30% glass filled nylon 66
Hub material	Aluminium 6061

User input boxes are yellow

	Notes	Value	Units	Reference
Blade mass		0.42	kg	
Radius of blade CG		0.23	m	
Tip radius		0.55	m	
Debit factors				
Material Degradation	eg moisture content	1.2		Multiwing published data
Material scatter	material data is typical not min	1		
Proof load factor	required safety factor	2		
Ultimate load factor	required safety factor	1.5		
Product of Debit Factors		3.6		
Test failure load	Test date xx/xx/xx	18	kN	

Safe fan speed		2172.5	rpm
Safe tip speed		125.1	m/s

8 References

<Insert references here>

Signed:

Witness: